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Initial

SECURITY CLASSIFICATION ~~Secret~~

SUBJECT AVRO CF-105 PRELIMINARY VENTRAL FIN TESTS

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ISSUED TO Internal

1.0 INTRODUCTION

There are indications that it is desirable to strive for higher values of C_{n_ψ} than those associated with many current high speed fighter configurations (Ref. 1). One method of improving C_{n_ψ} would be the use of ventral fins and it was thought that this might give an improvement without compromising the aircraft in other ways. Consequently advantage was taken of a short period of free time in the No. 3 Wind Tunnel to do some ventral fin tests on the CF-105 low speed wind tunnel model, and it was hoped that an indication of the effectiveness of the ventral fins could be obtained.

Because of the short testing time available the tests had to be preliminary in nature, and unfortunately there was considerable "scatter" in the data obtained. Therefore, from these tests it is not possible to draw accurate quantitative conclusions. However, the data do indicate that the ventral fins increase C_{n_ψ}, and in most cases by more than 30 percent.

2.0 MODEL GEOMETRY AND DATA REDUCTION

The model used was of the Series III aircraft and its geometry is as follows:

Model scale = 0.07

Wing area = 6.003 ft^2

Wing span = 3.50 ft.

Wing mean aerodynamic chord = 2.115 ft.

Wing aspect ratio = 2.048

The model was mounted on twin wing strut supports and a rear single strut used for changing angle of attack. The position of the twin strut pick-up points corresponds to 27% M.A.C. The yawing moment data are referred to 27% M.A.C. and the wind tunnel balance axes system.

The tests were carried out with a working section dynamic pressure of 37.4 lbs/ft^2.

3.0 VENTRAL FINS

The four fin configurations used (Figs. 1 and 2)* were designed to satisfy aircraft ground clearance requirements. With the exception of No. 1A the fins were mounted in pairs, one fin on each side of the aircraft at an angle of 30° to the vertical. In the case of No. 1A, one vertical fin was used. This fin was designed to have the same outline as the projected side view of fins No. 1.

4.0 TEST RESULTS - VENTRAL FINS

Yaw runs from -12 to +12° yaw were made at 0, 10 and 20° angle of attack. The data are shown plotted in Figs. 3 to 6. At +2° and -4° it is seen that the slope of the yaw curve changes. It is between these values of yaw angle that the derivative, C_{n_ψ}, is of particular interest; therefore, the data were replotted for this range on an expanded scale. One such plot is included (Fig. 7). C_{n_ψ} for the four configurations and for the clean aircraft is plotted as a function

* Also Figs. 10 to 15.

of angle of attack in Fig. 8. The scatter in Fig. 7 demonstrates the problem encountered throughout the analysis in determining C_{n_ψ}. The value that should be used for the clean aircraft is questionable, and since the entire study is dependent on a comparison to the clean aircraft, the difficulty in drawing accurate conclusions is apparent.

A yawing moment test was also carried out for the clean aircraft with the vertical tail off. These data (Fig. 9) show that the C_n - ψ non-linearity exists without the tail.

5.0 CONCLUSIONS

(1) The tests indicate that ventral fins of the type tested increase C_{n_ψ} in most cases by more than 30 percent. For example at $\alpha = 20°$, C_{n_ψ} for the clean aircraft was 0.00061, and with ventral fins No. 1 it was 0.00089, which is an increase of 46 percent.

(2) The information available from these tests has been seriously limited by the short test period and by the scatter of the data points. However, the ventral fin tests do indicate some improvement in C_{n_ψ}, and therefore it would be be desirable to conduct a more detailed and more accurate study of the application of ventral fins to this aircraft.

6.0 FUTURE TESTS

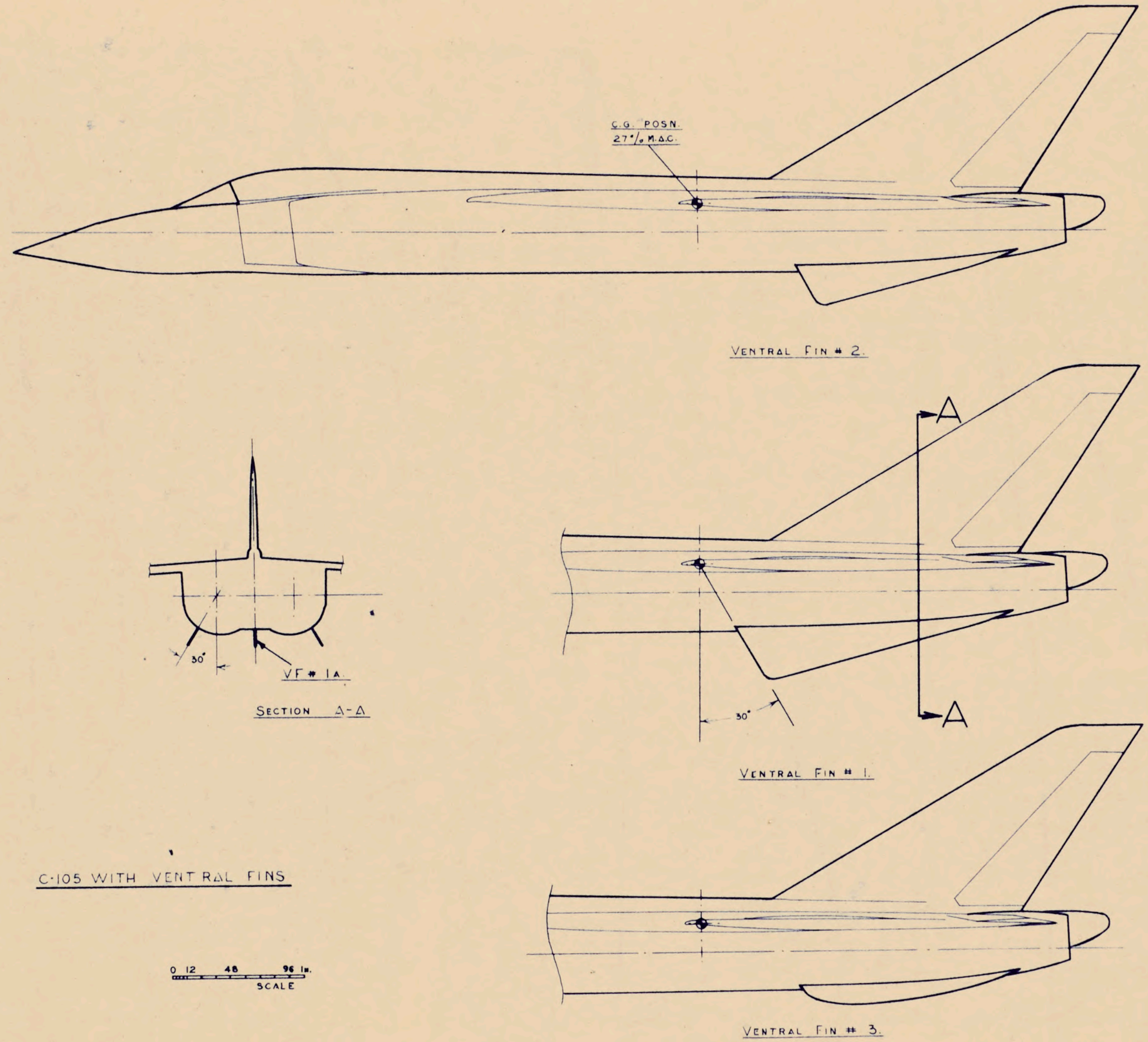
In order to obtain accurate quantitative information on the effectiveness of ventral fins, future tests should be carried out at higher values of working section dynamic pressure which should reduce the scatter of the data points. In addition, enough time should be allocated so that more data points can be obtained.

7.0 REFERENCES

1. Heppe, R. Richard — Airplane Design Implications of the Inertia Coupling Problem. I.A.S. Preprint No. 723.

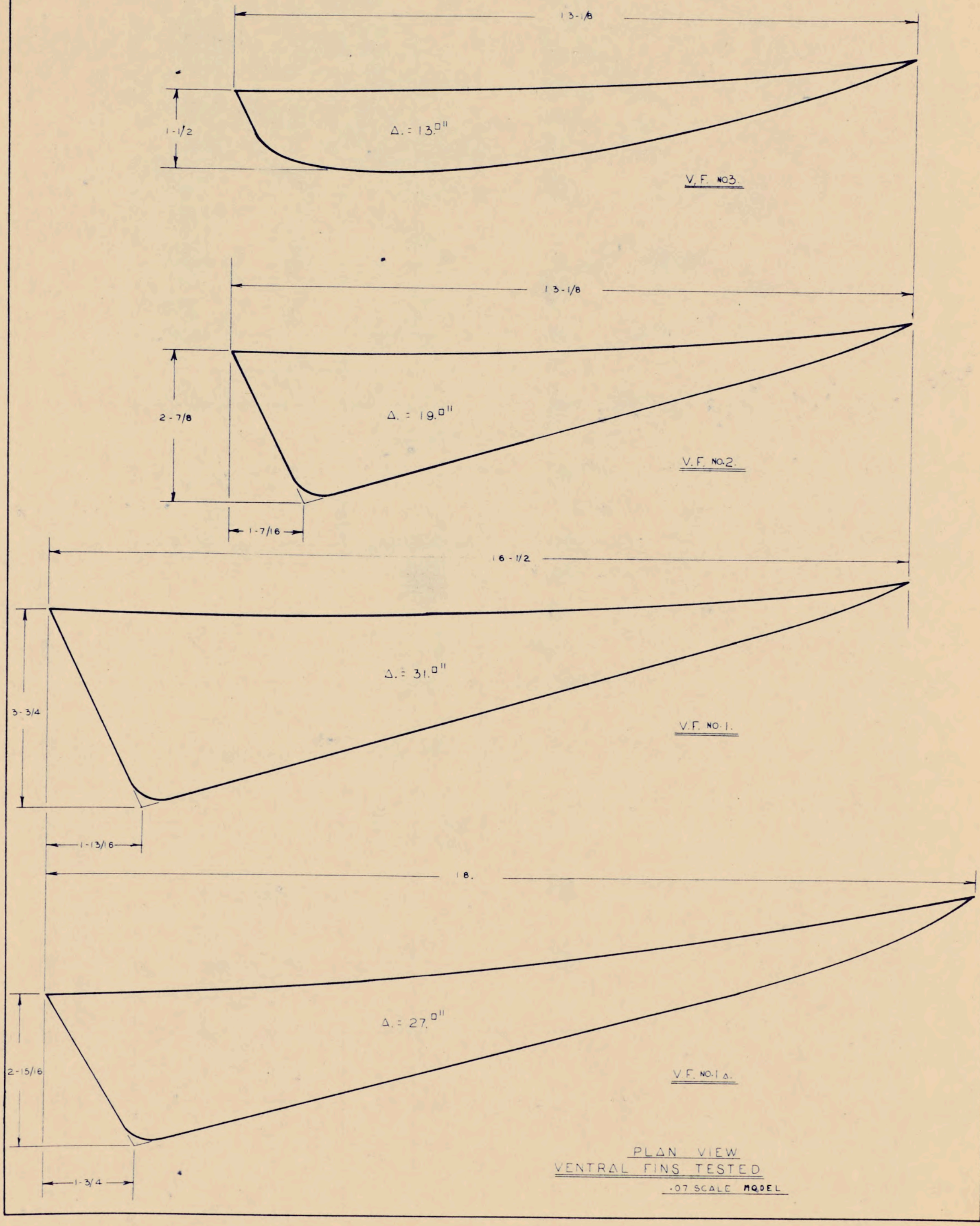
RLW/FM

FIG. 1.



C·105 WITH VENTRAL FINS

FIG. 2.



PLAN VIEW
VENTRAL FINS TESTED
.07 SCALE MODEL

CF-105 VENTRAL FIN TESTS
VENTRAL FIN NO. 1

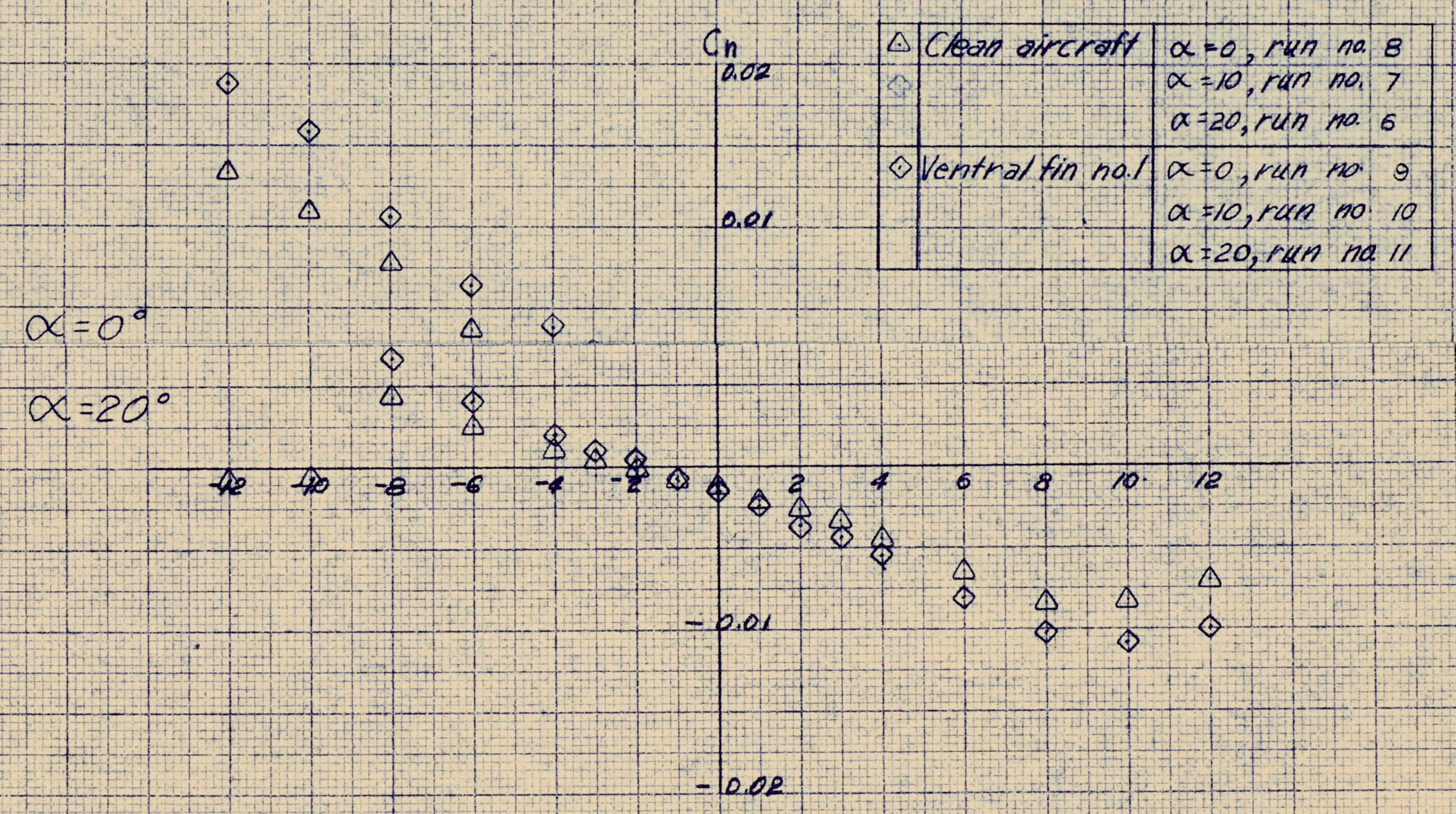


FIG. 3

CF-105 VENTRAL FIN TESTS
VENTRAL FIN NO. 1

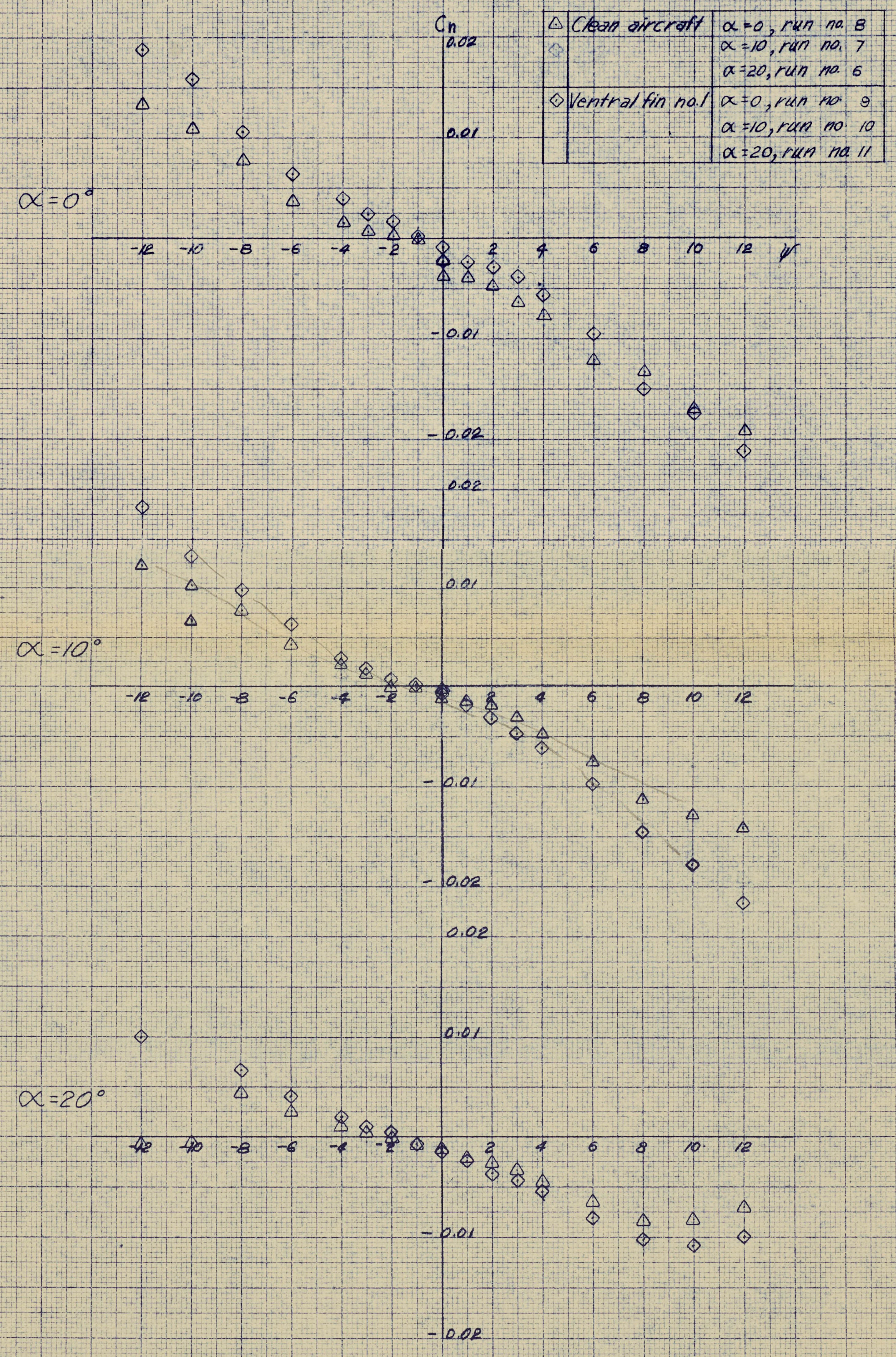
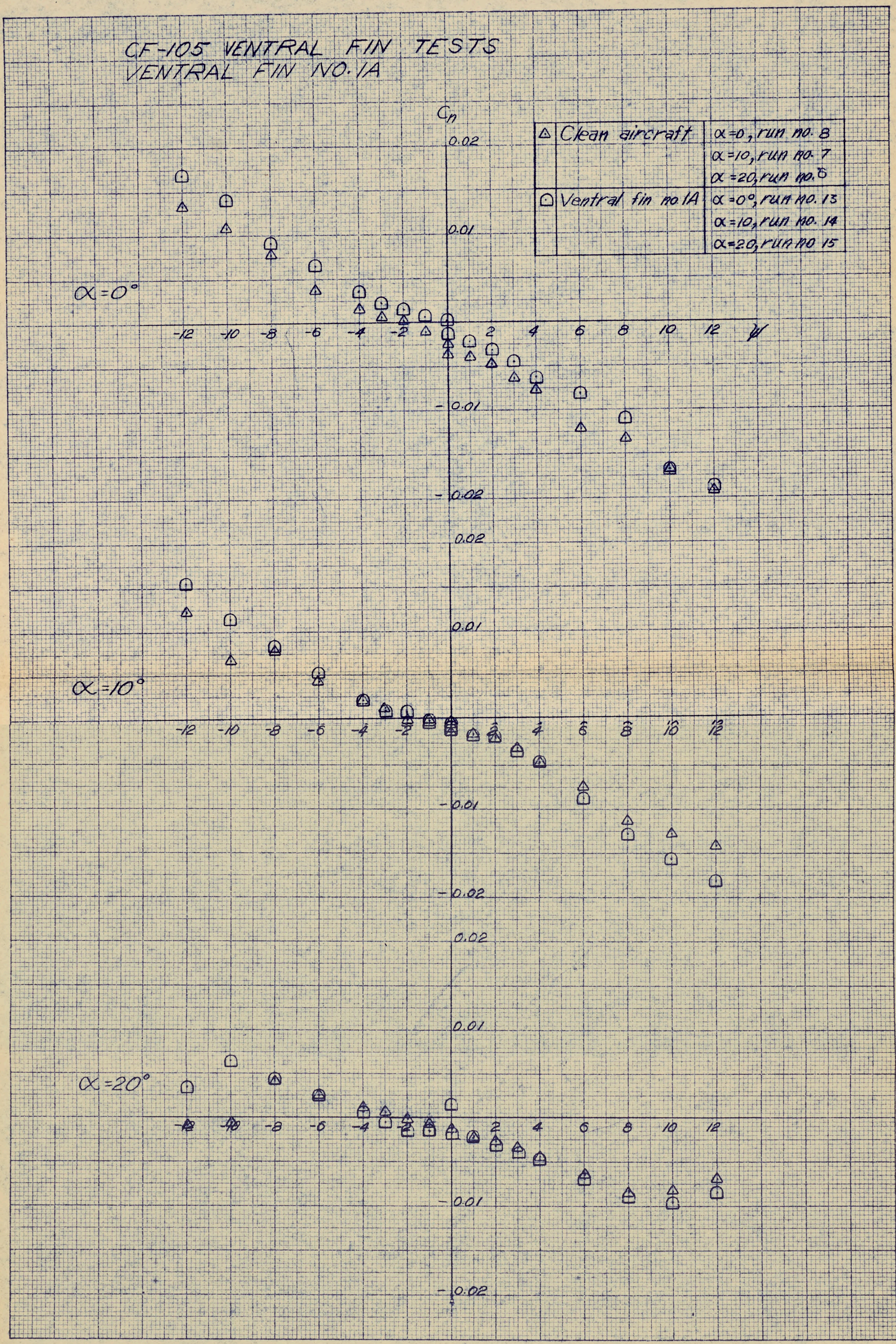


FIG. 3



CF-105 VENTRAL FIN TESTS
VENTRAL FIN NO. 1A
Cn
△ Clean aircraft
α=0, run no. 8
α=10, run no. 7
α=20, run no. 6
□ Ventral fin no 1A
α=0°, run no. 13
α=10, run no. 14
α=20, run no 15
α=0°
α=10°
α=20°
ψ
0.02
0.01
-0.01
-0.02
-12
-10
-8
-6
-4
-2
2
4
6
8
10
12

FIG. 4

CF-105 VENTRAL FIN TESTS
VENTRAL FIN NO. 2

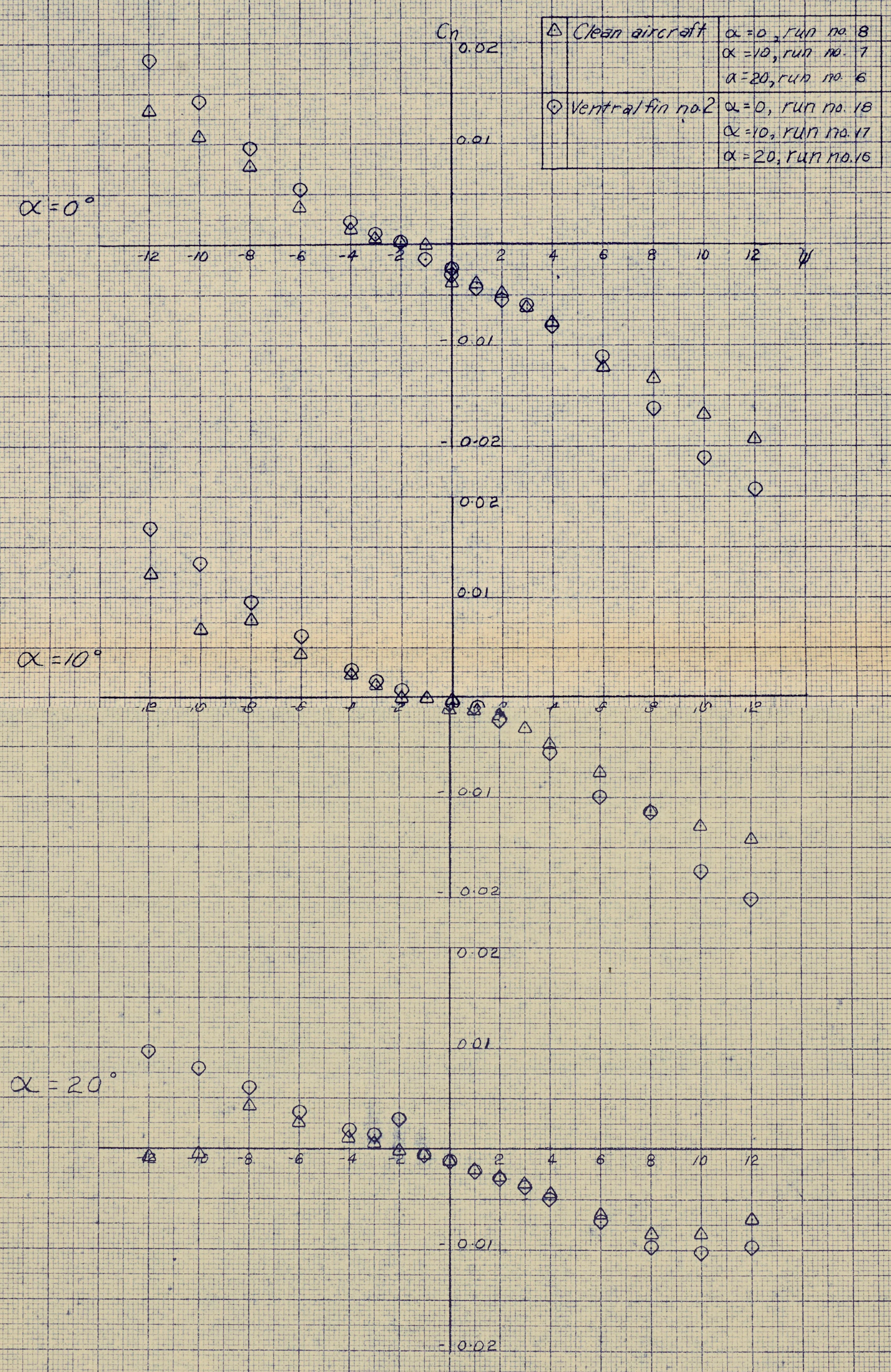


FIG. 5

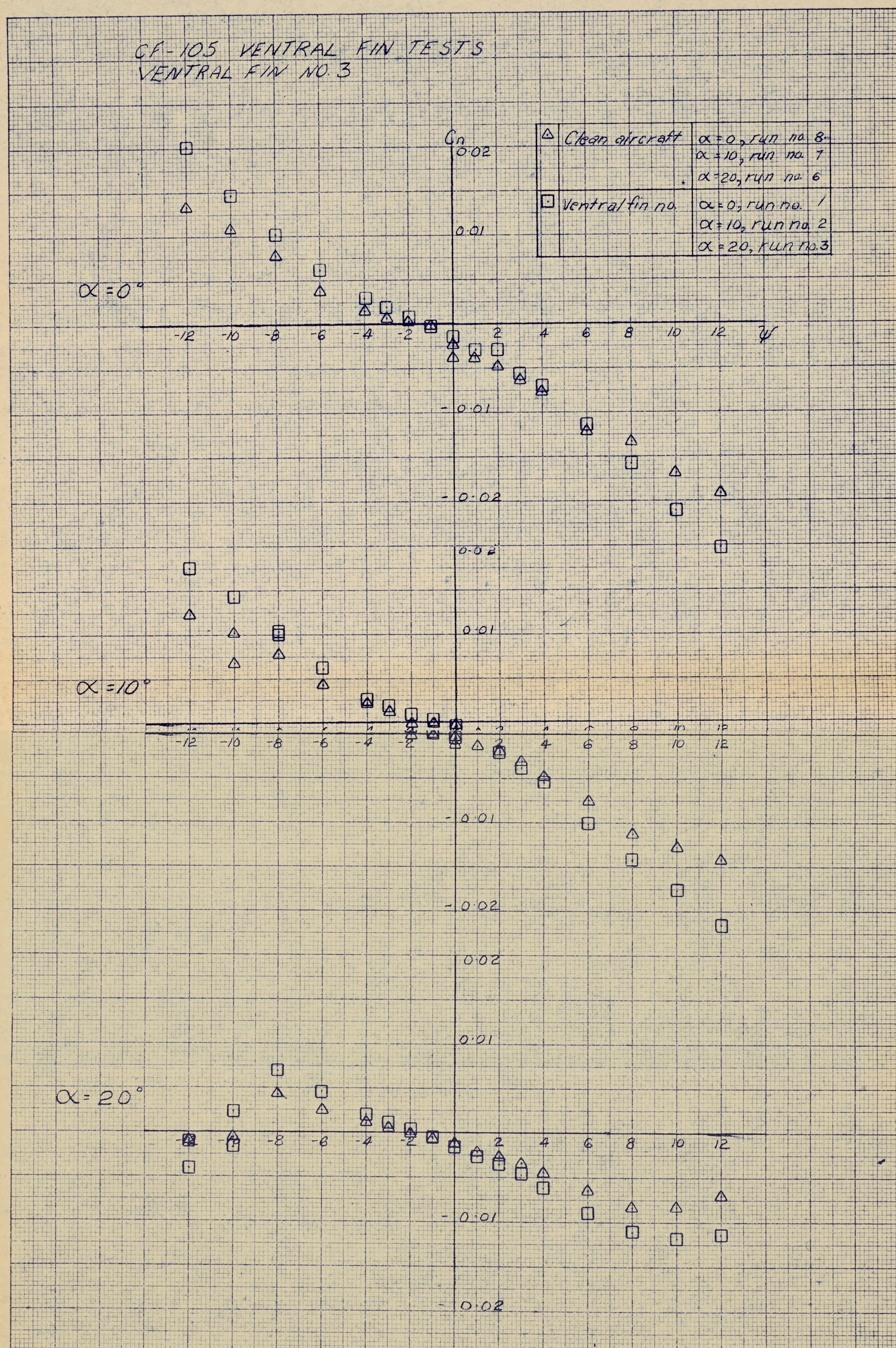

CF-105 VENTRAL FIN TESTS
VENTRAL FIN NO. 3
Clean aircraft
α = 0, run no. 8
α = 10, run no. 7
α = 20, run no. 6
Ventral fin no.
α = 0, run no. 1
α = 10, run no. 2
α = 20, run no. 3
Cn
ψ
α = 0°
α = 10°
α = 20°
0·02
0·01
-0·01
-0·02
-12
-10
-8
-6
-4
-2
2
4
6
8
10
12

FIG. 6

FIG 7

CF-105 VENTRAL FIN TESTS

$\alpha = 0°$

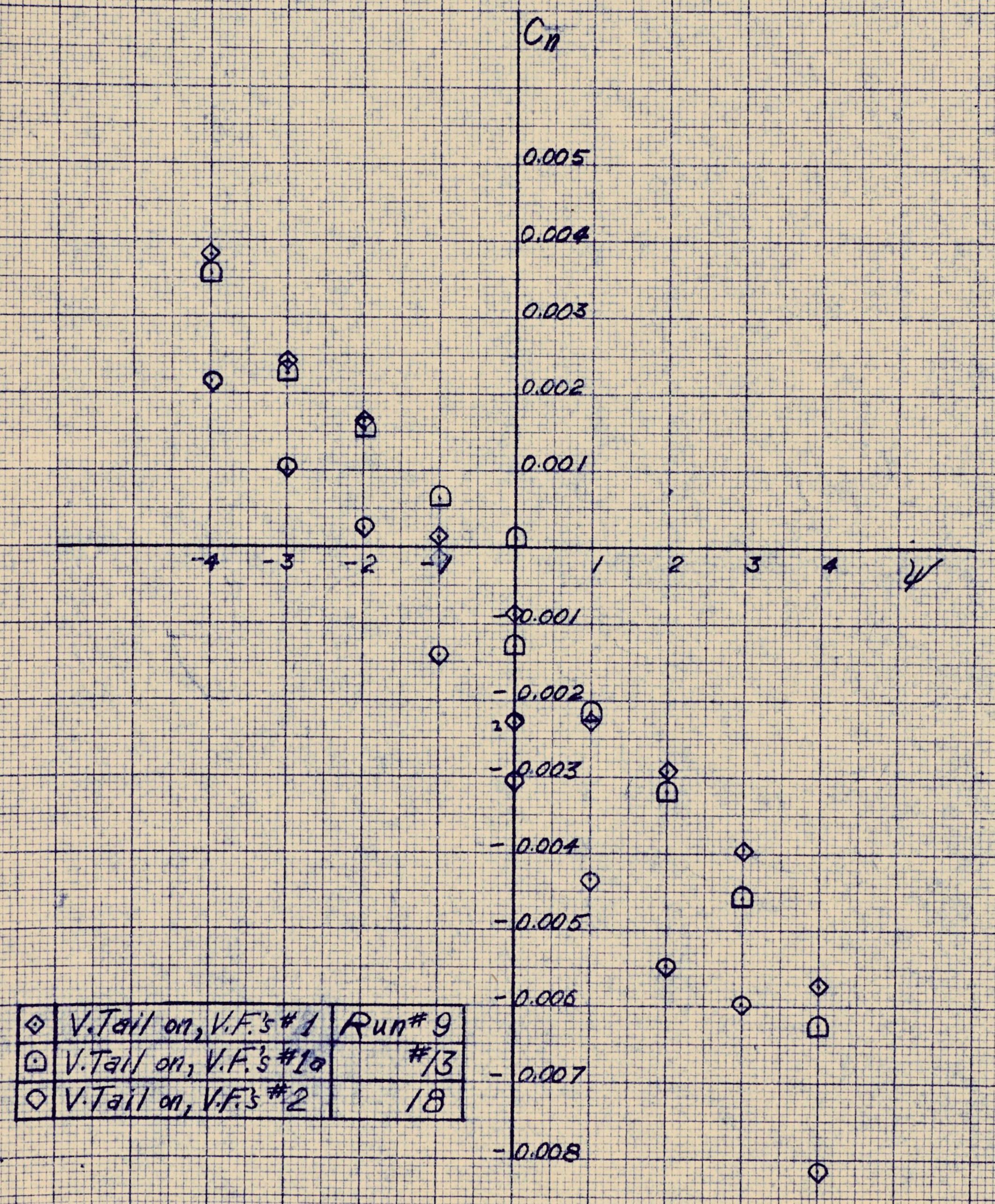
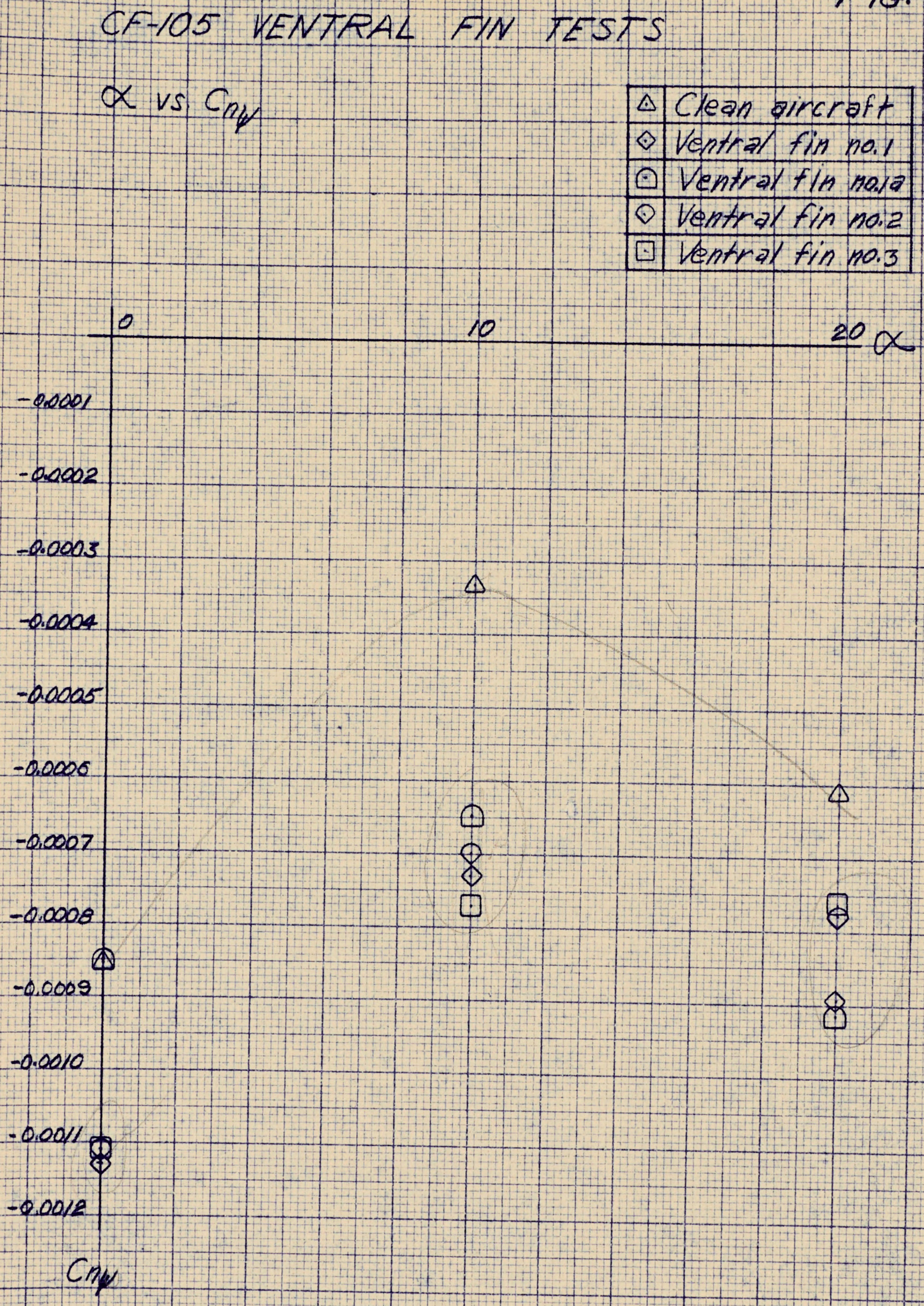


FIG. 8


CF-105 VENTRAL FIN TESTS
α vs $C_{n\psi}$
Clean aircraft
Ventral fin no.1
Ventral fin no.1a
Ventral fin no.2
Ventral fin no.3
0
10
20
α
-0.0001
-0.0002
-0.0003
-0.0004
-0.0005
-0.0006
-0.0007
-0.0008
-0.0009
-0.0010
-0.0011
-0.0012
$C_{n\psi}$

CF-105 VENTRAL FIN TESTS

VERTICAL TAIL OFF

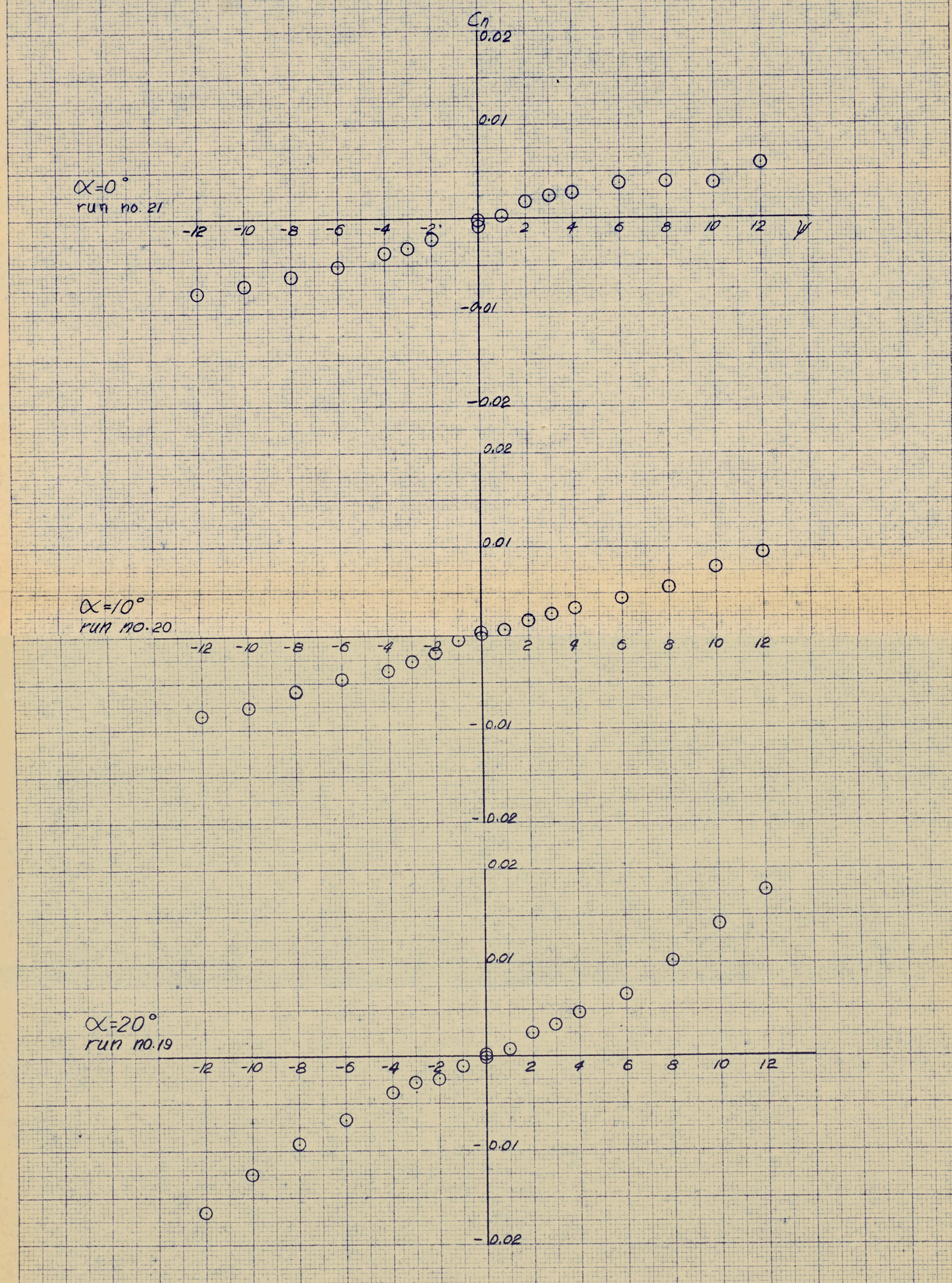


FIG. 9

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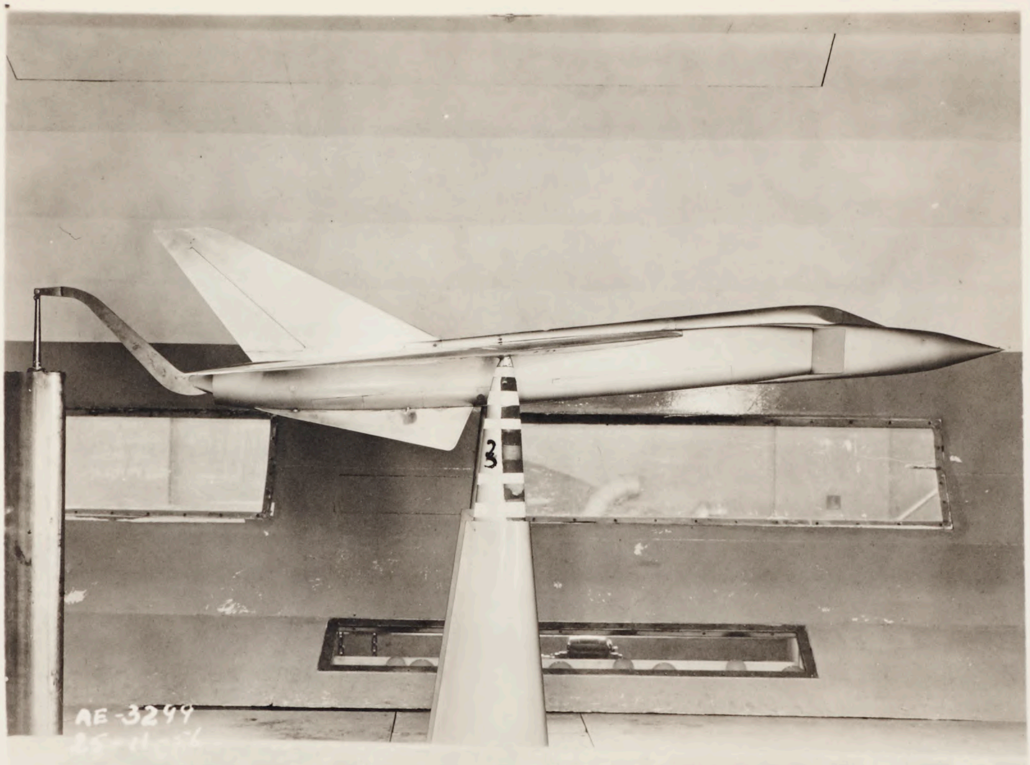

VENTRAL FIN NO. 1

FIG. II

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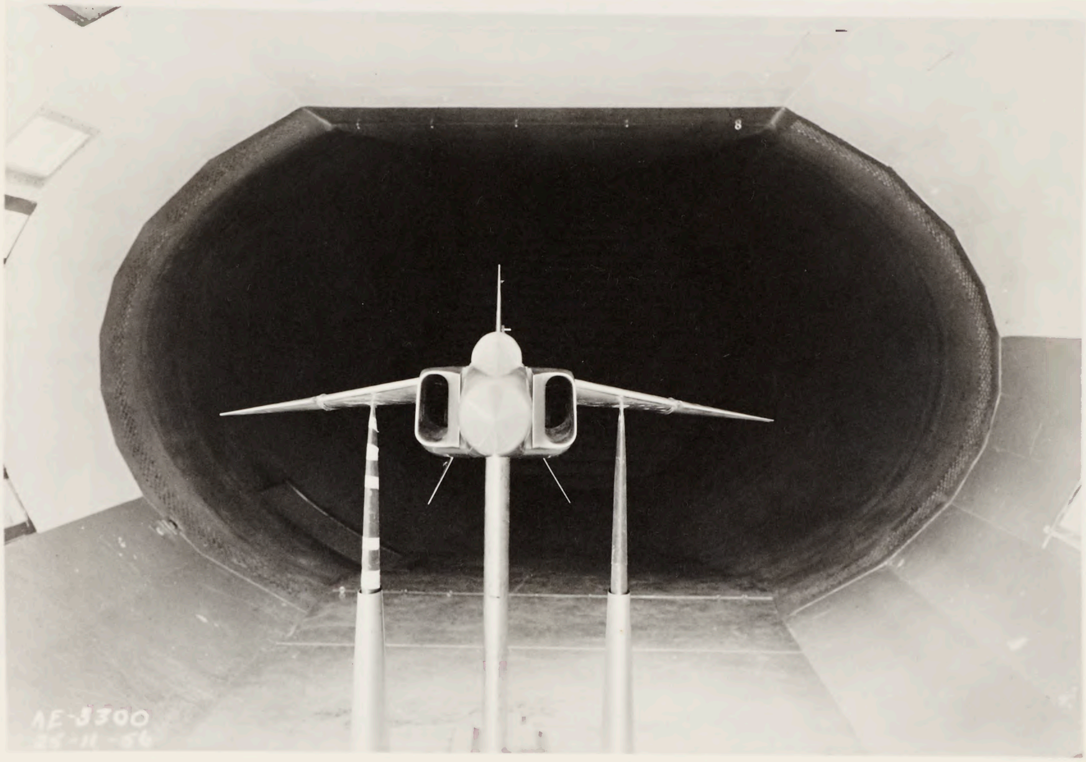

VENTRAL FIN NO. I

FIG. 12

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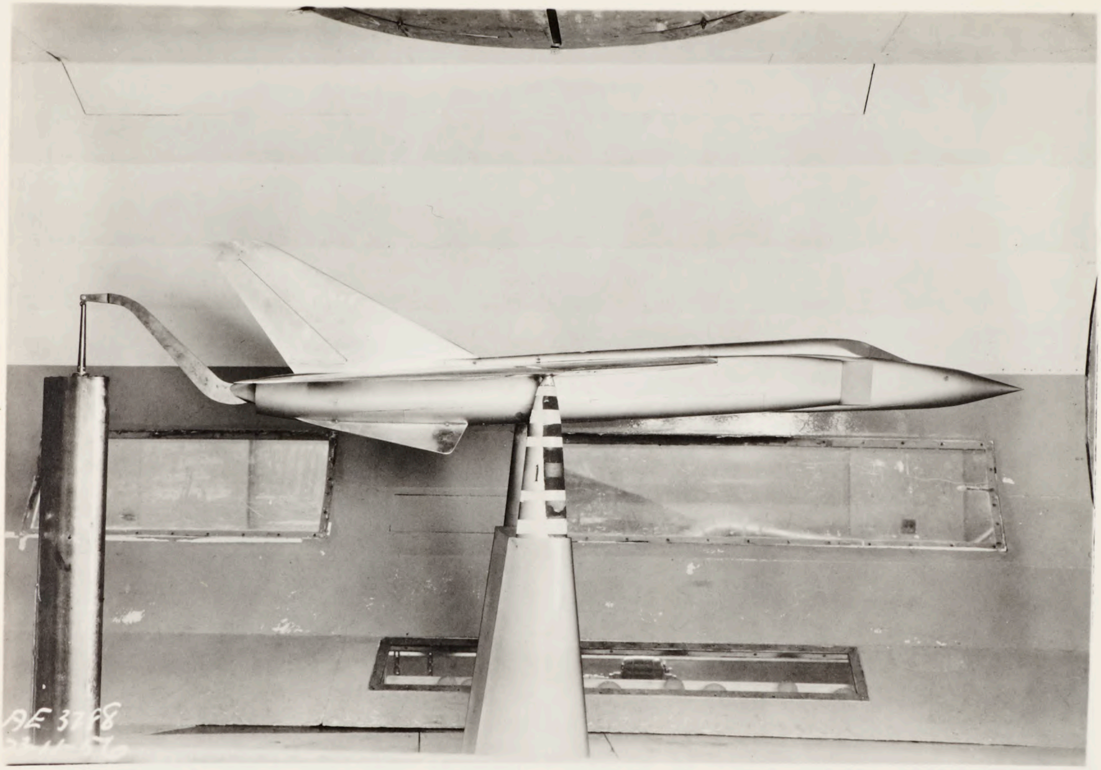

VENTRAL FIN NO. 2

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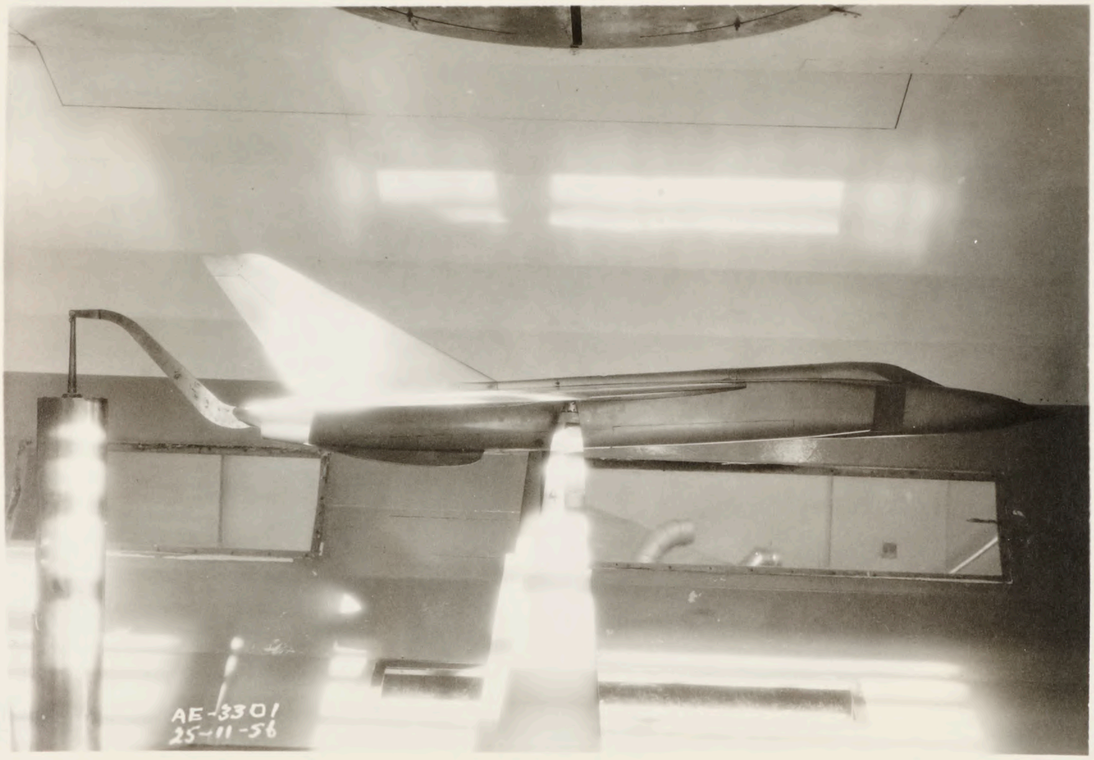

VENTRAL FIN NO. 3

FIG. 15

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